2/22

October 27, 1983

TESTIMONY BY

Samuel Milham, Jr., M.D., M.P.H.

REPRESENTING

Washington State Department of
Social and Health Services

BEFORE

Environmental Protection Agency Hearing on
Proposed Standards for High-Arsenic Copper Smelters
November 2, 1983

My name is Samuel Milham, Jr. I am a physician employed as Head of the Epidemiology Section at the Washington State Department of Social and Health Services.

In the early 1970s, children living near a lead smelter in Texas were shown to have high blood lead levels. In 1972, DSHS launched a series of studies to investigate the nature of exposure to heavy metals in people living in Ruston, near the ASARCO Copper Smelter.

Initial studies indicated that blood lead levels and blood enzymes affected by lead were within normal limits. However, arsenic levels in urine and hair in children residing near the Smelter were elevated as compared to children who resided at a distance (8 miles) from the Smelter[1]. Levels of arsenic in urine, house dust, and soil were found to decrease rapidly with distance of residence from the Smelter. Urinary arsenic levels varied synchronously over a 5-week period suggesting that inhalation was the most likely route of exposure. A decreasing linear relationship is seen between urinary arsenic and increasing age with younger children having consistently higher levels.

During a strike at the Tacoma Smelter in 1974, urinary arsenic levels in the community were lower than when processing resumed, suggesting a direct impact of the Smelter arsenic emissions on human exposures, most likely mediated by inhalation[2]. Urinary arsenic levels in the years since 1972 have shown variation over time, but no clear time trend is demonstrated in the urinary arsenic levels of Ruston children. In 1975, Ruston children averaged 35 micrograms of arsenic per liter of urine: in 1983, they averaged 36 micrograms of arsenic per liter of urine.

In an attempt to assess the health impact of arsenic exposure in the community around the ASARCO Tacoma Smelter, a number of studies have been done:

1. Absenteeism in Ruston Elementary School was found to be no different than in 6 other Tacoma elementary schools[3].

2. Pure tone hearing screening tests done in the Ruston Elementary School gave similar results to those done at other Tacoma elementary schools[3].

3. Pure tone threshold audiometry done on 7 Ruston children with high urinary arsenic levels ($\geq$ .2 PPM on 2 or more sample days) was normal[3].

4. Average blood values of 33 Ruston Elementary School children were found to be the same as those of 25 control children (Fern Hill Elementary School).

5. Chromosome analysis (sister chromatid exchange) was normal in 5 arsenic exposed Ruston children and in 5 unexposed controls.

6. Growth and development of Ruston School children, as measured by height and weight attained at a given age, was found to agree with U.S. averages. Academic and physical performance of Ruston Elementary School children was similar to that of other Tacoma elementary school children.

7. Mortality due to lung cancer in the census tracts near the Smelter was not elevated compared to more distant tracts for deaths in the years 1950-1970.

8. Follow up of children enrolled at Ruston Elementary School for 3 or more years during the years 1900-1919 was attempted. Survivorship of 137 males in the group was found to be favorable (more survivors to 1980 than expected).

Published studies of health effects in the communities around other arsenic emitters[4-13] are all essentially negative.

In spite of the failure to date to delineate any adverse health effects due to arsenic in the community around the ASARCO Tacoma Smelter, I feel that it would be prudent to minimize human exposure to arsenic by reducing arsenical emissions to the lowest level possible. It is especially important that low-level or fugitive emissions be reduced. To this end, I recommend:

1. Setting a community 24-hour ambient air arsenic standard.

2. Establishing an air sampling network in the impacted communities to monitor ambient air arsenic.

3. Monitoring urinary arsenic levels of people residing in the impacted communities on a regular basis.

References

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ASARCO

LOW VOLUME MONITORING SITES

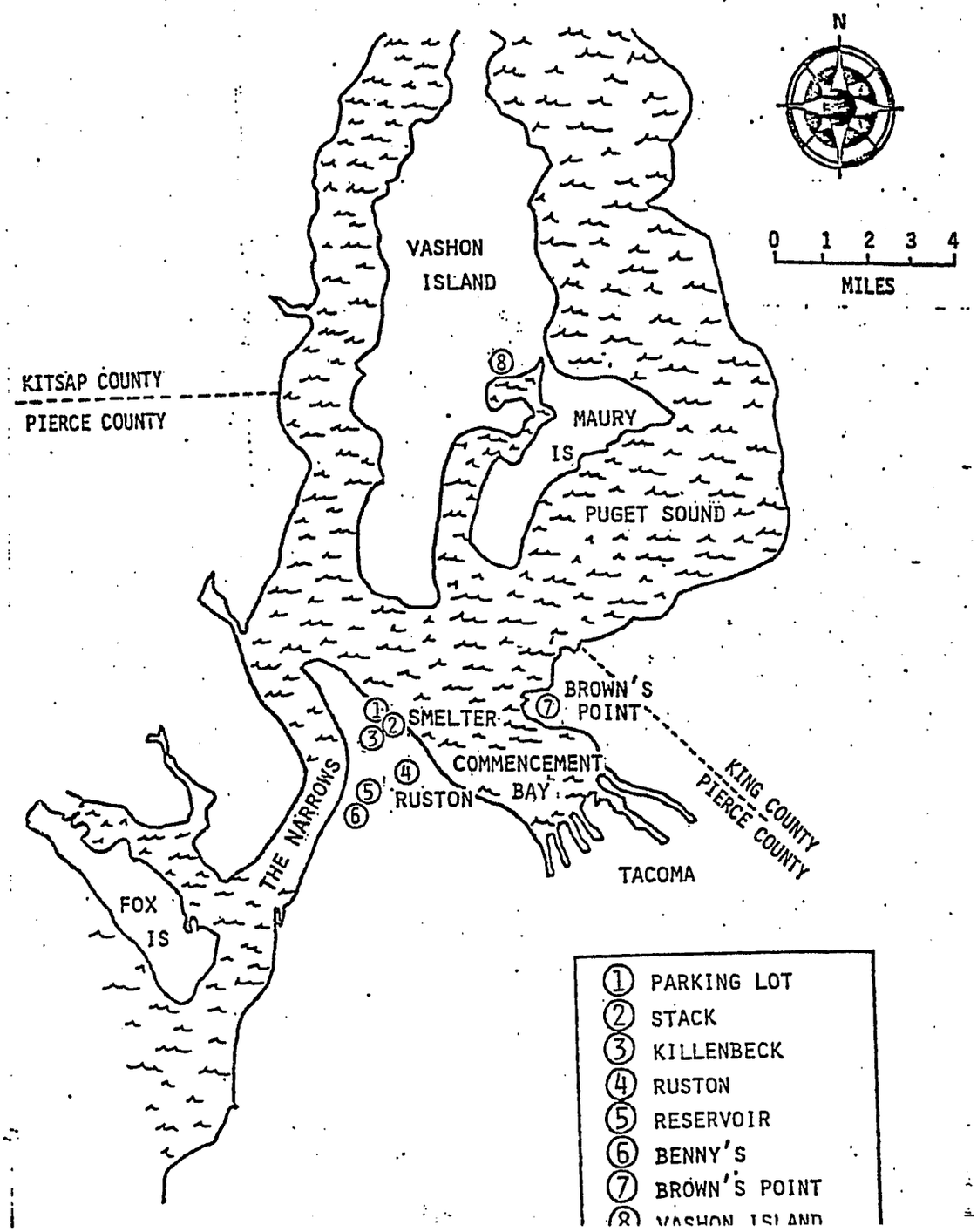
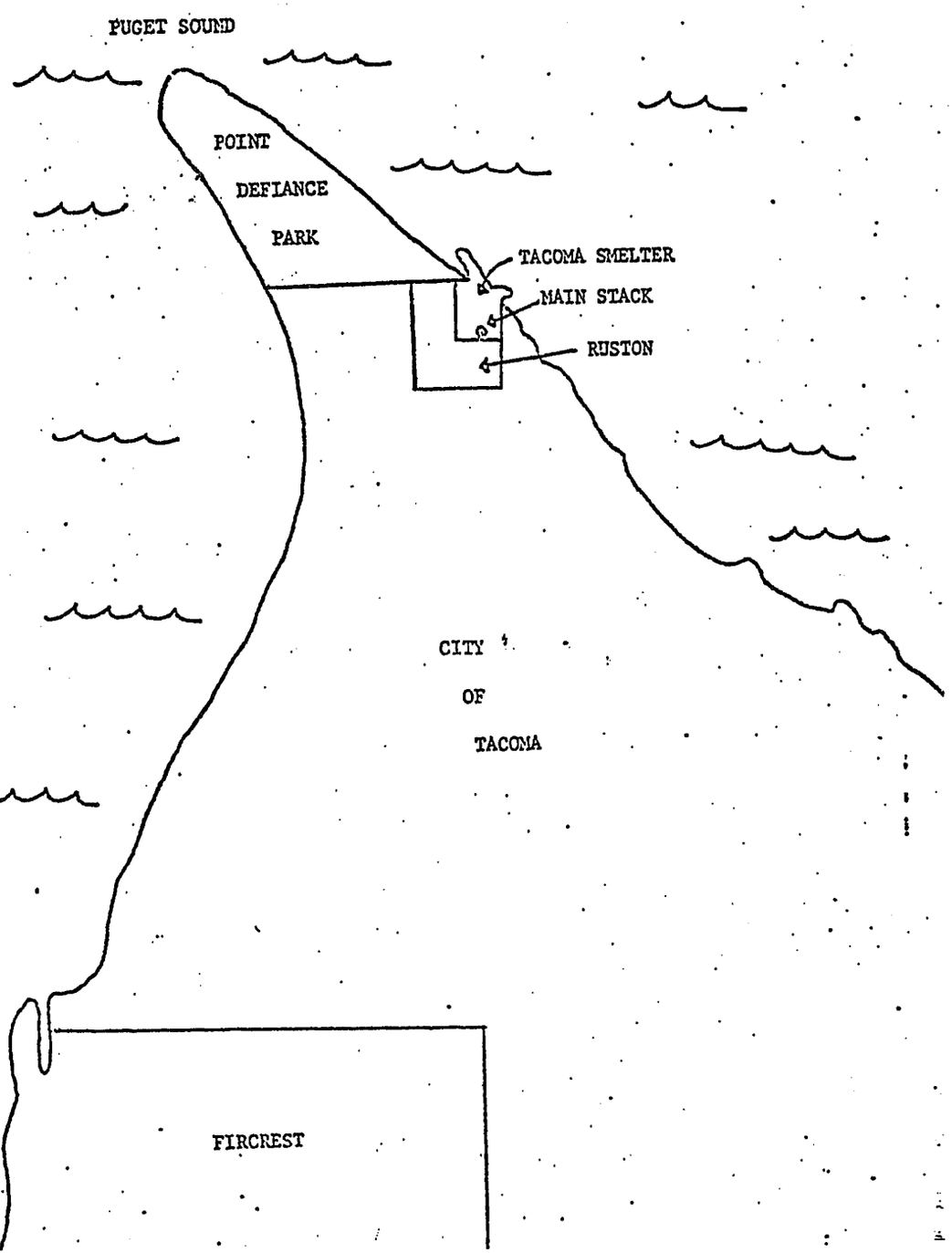


FIGURE 1 Location of Tacoma Smelter and Ruston In Relation to the City of Tacoma



BLOOD LEAD BY SCHOOL
JUNE 7, 1972

UG/100 ML	NUMBER OF STUDENTS RUSTON	FERN HILL
0-4	0	0
5-9	12	5
10-14	2	6
15-19	9	7
20-24	2	3
25-29	2	1
30+	0	0
TOTAL	27	22
MEAN	14.7 UG/100 ML	15.8 UG/100 ML

Fig. 2 URINARY ARSENIC BY SCHOOL

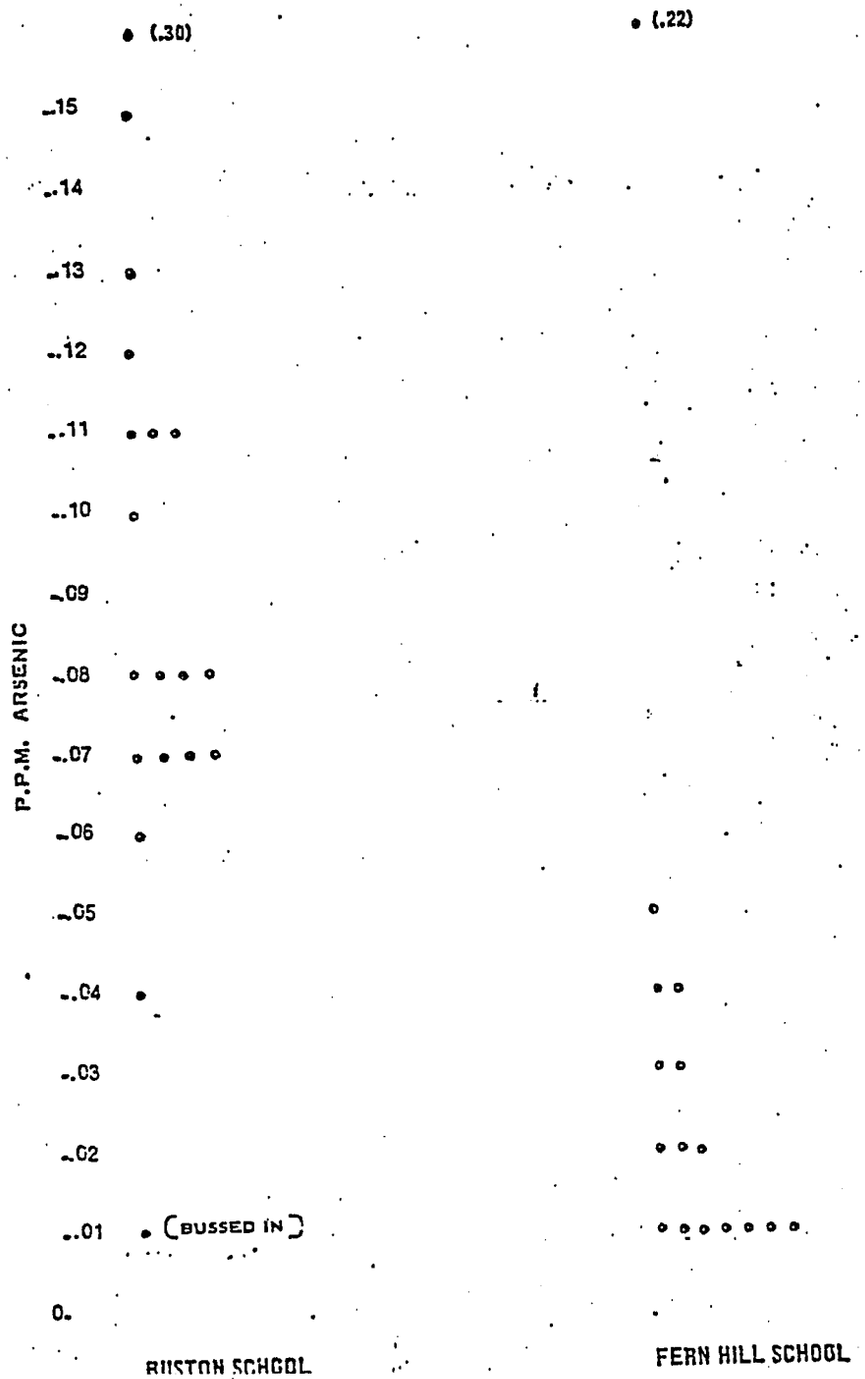


Fig.3 HAIR ARSENIC BY SCHOOL

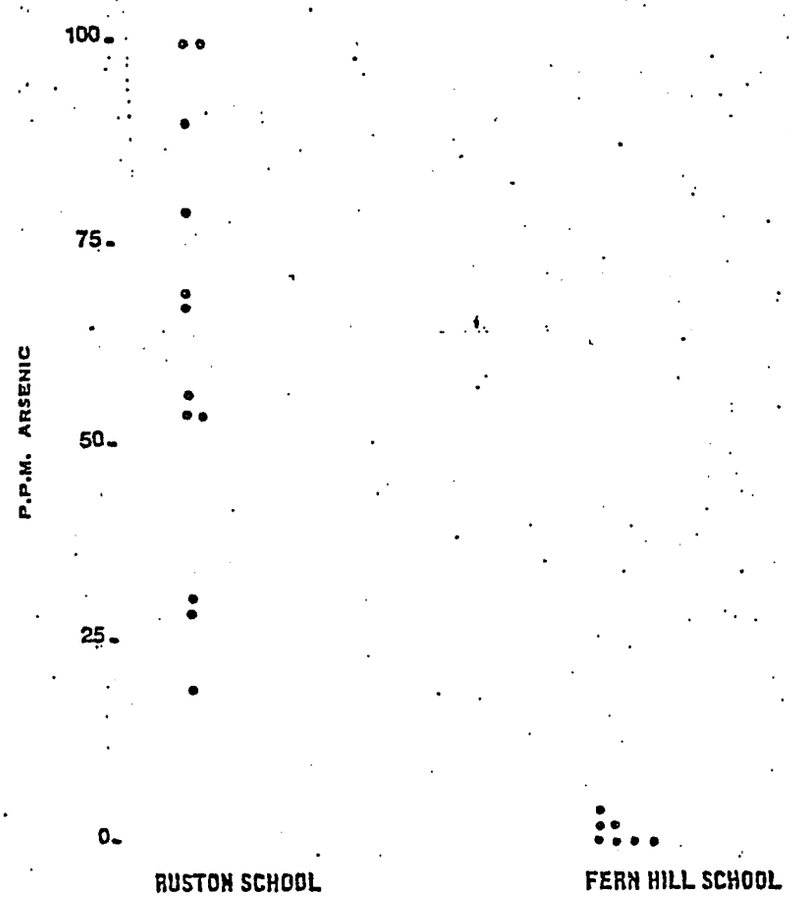


Fig. 5 URINARY ARSENIC IN RUSTON CHILDREN FOR 5 WEEKLY SAMPLES

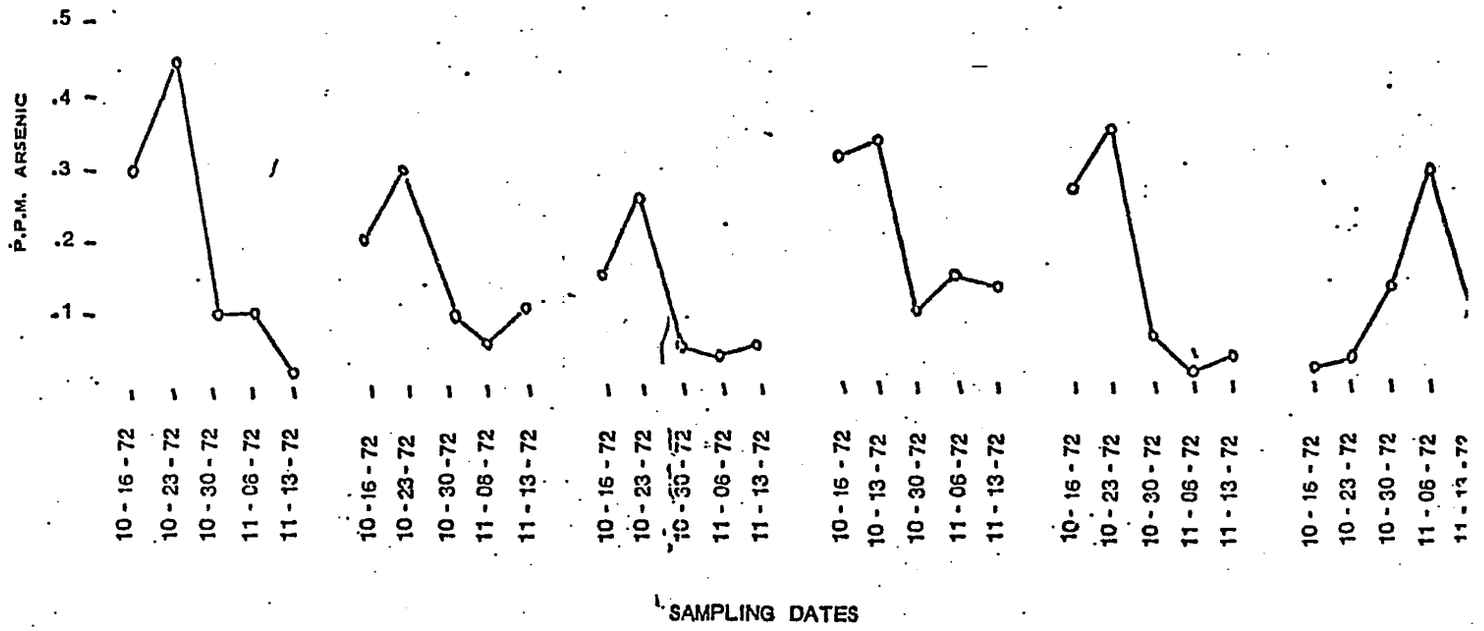
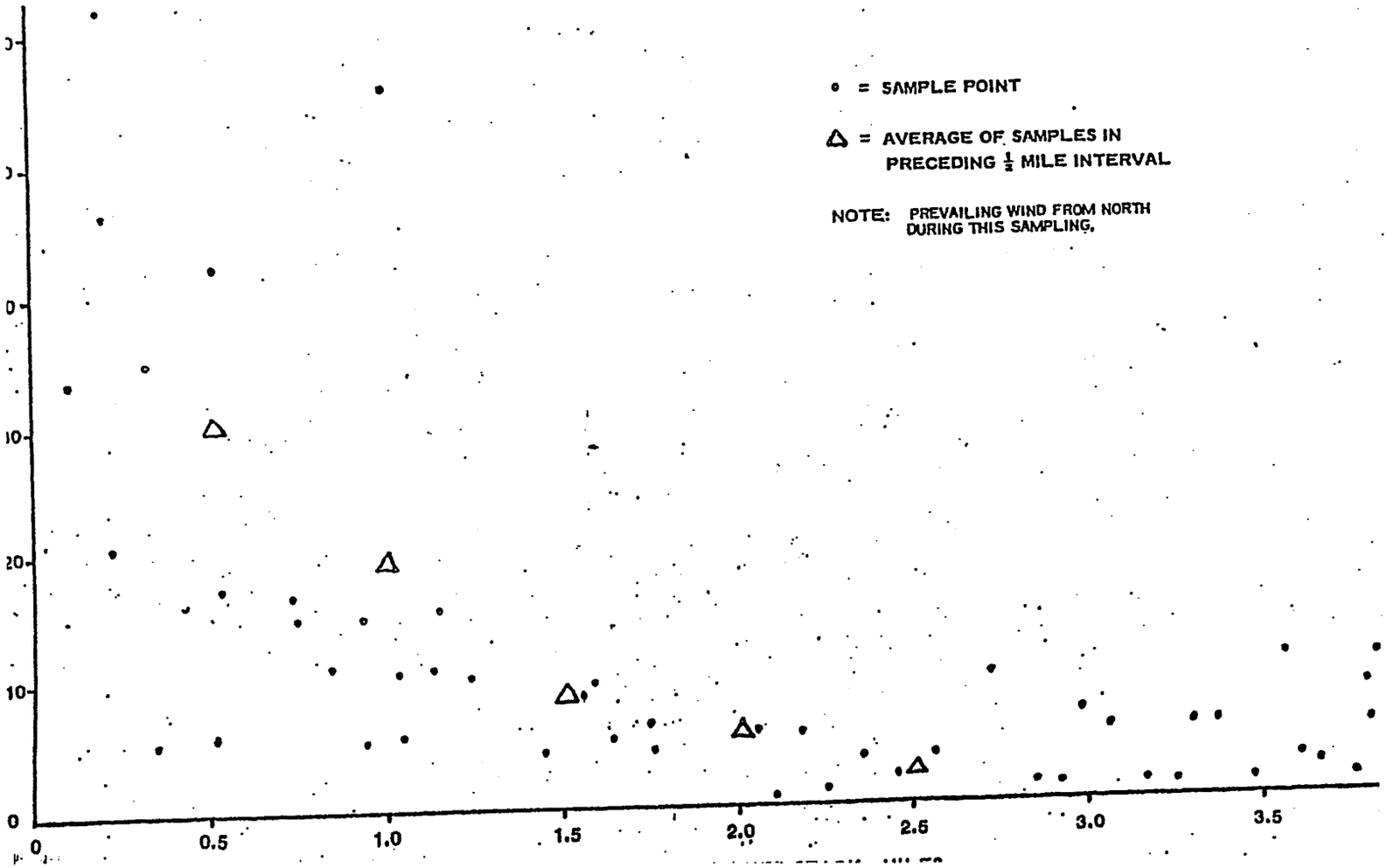


Fig.4 URINARY ARSENIC BY DISTANCE FROM SMELTER



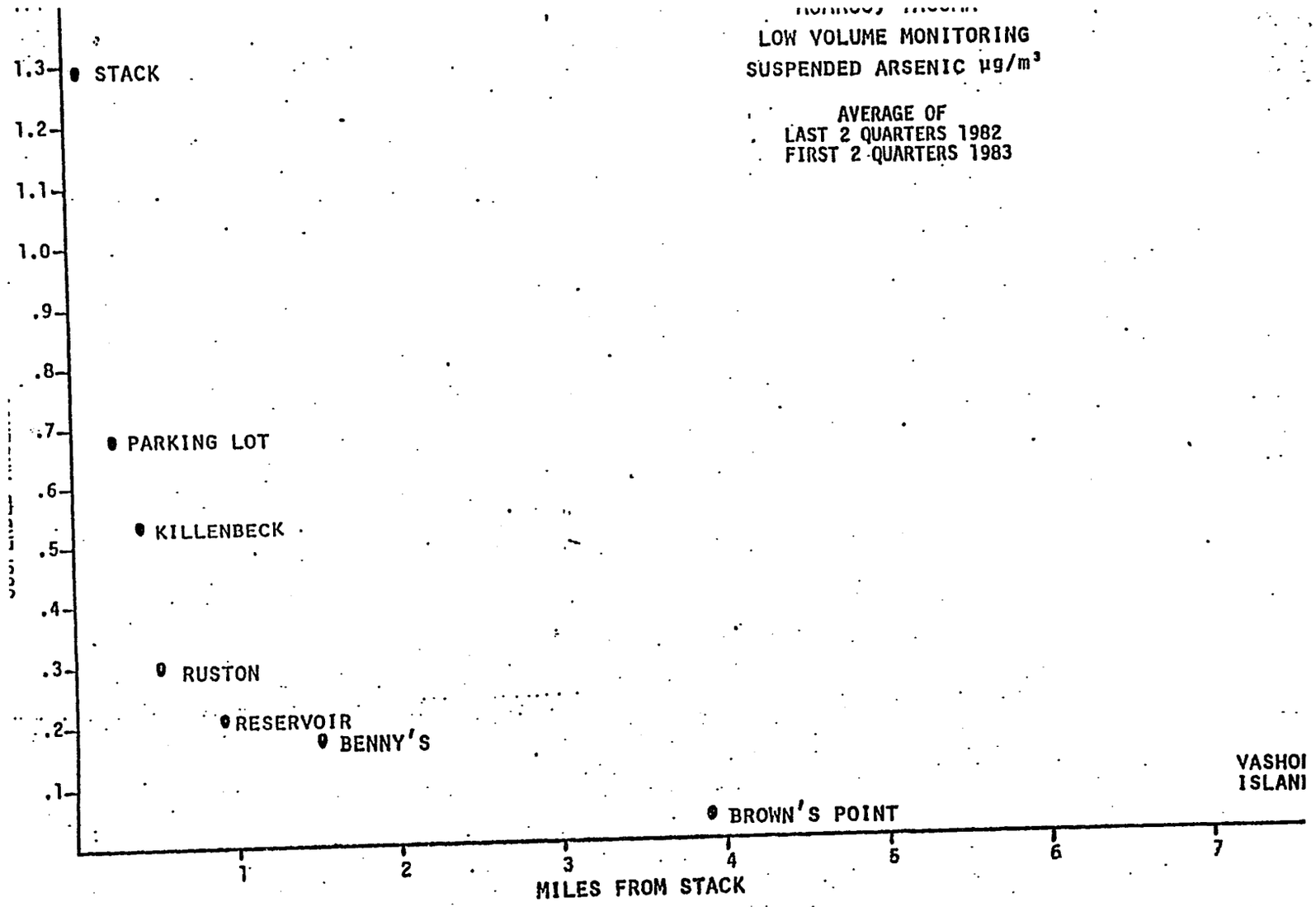


TABLE 1

Urinary and House Dust Arsenic by Distance from Smelter

Distance of Residence from Stack	Mean Urinary Arsenic in PPM	Vacuum Cleaner dust Arsenic in PPM	Attic Dust Arsenic in PPM
0 - .4 miles	.30	1300	2100
.5 - .9 miles	.19	970	
1.0 - 1.4 miles	.08	330	
1.5 - 2.0 miles	.06	no sample	
2.0 - 2.4 miles	.02	70	

e: Prevailing wind from the north at this sampling

Fig.6 URINARY ARSENIC BY AGE. AVERAGE OF 5 WEEKLY SAMPLES IN RUSTON CHILDREN.

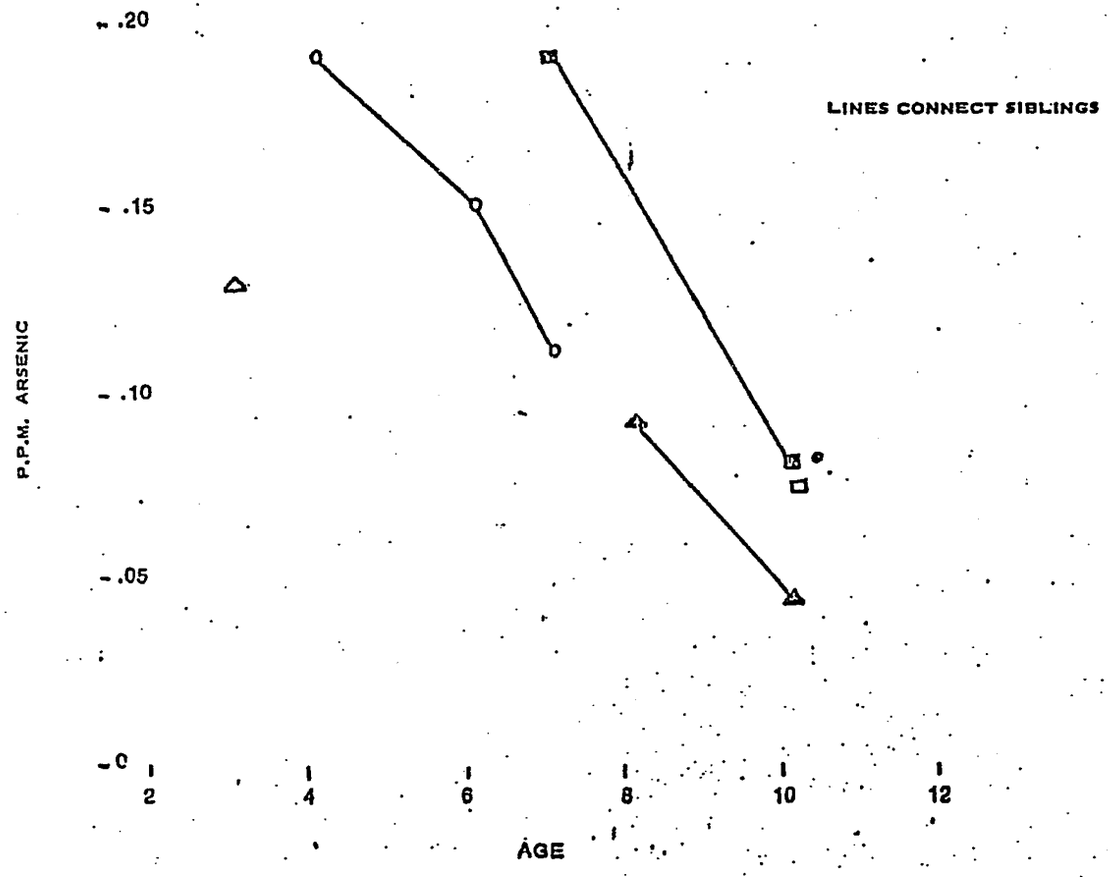
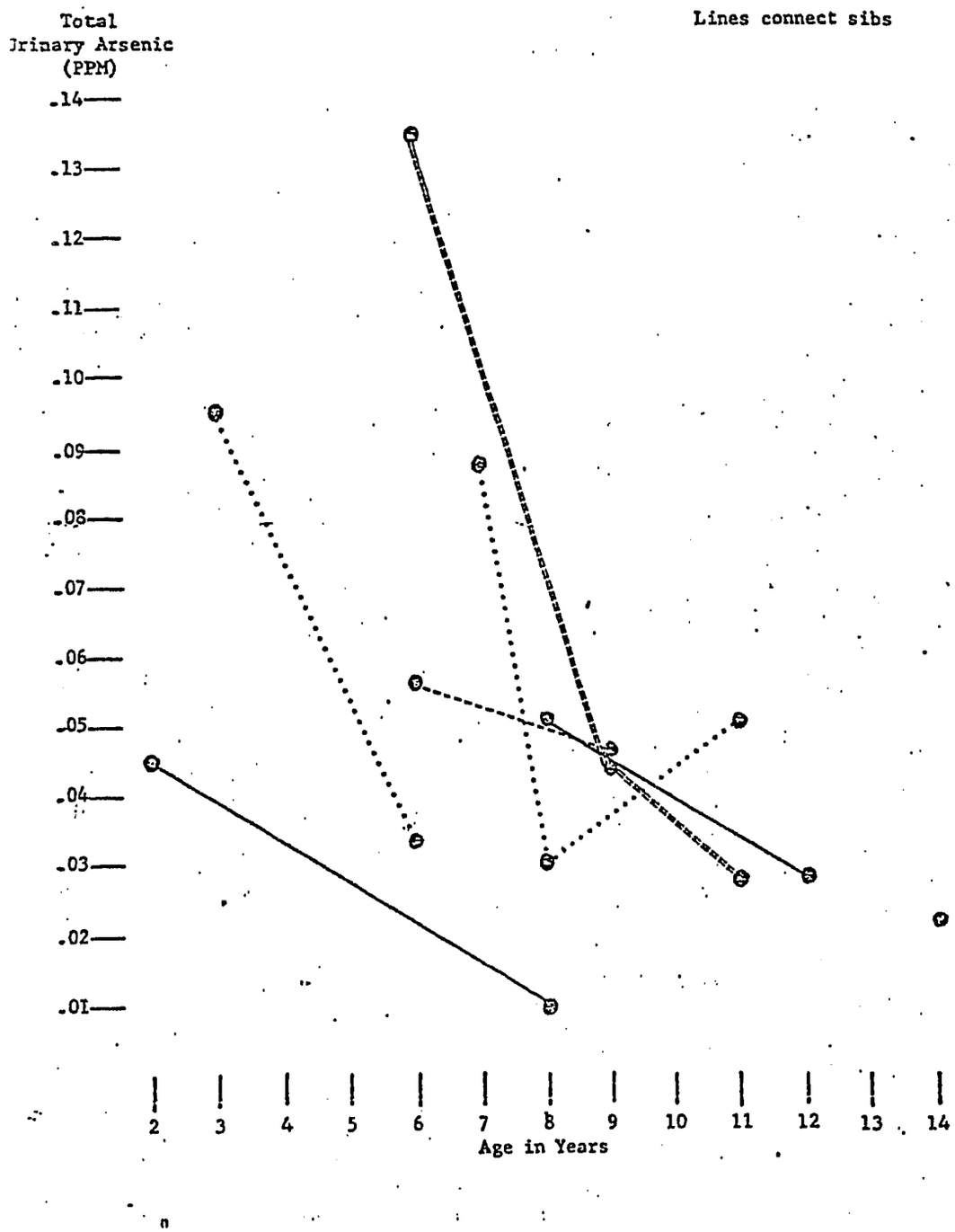


FIGURE 1

TOTAL URINARY ARSENIC BY AGE



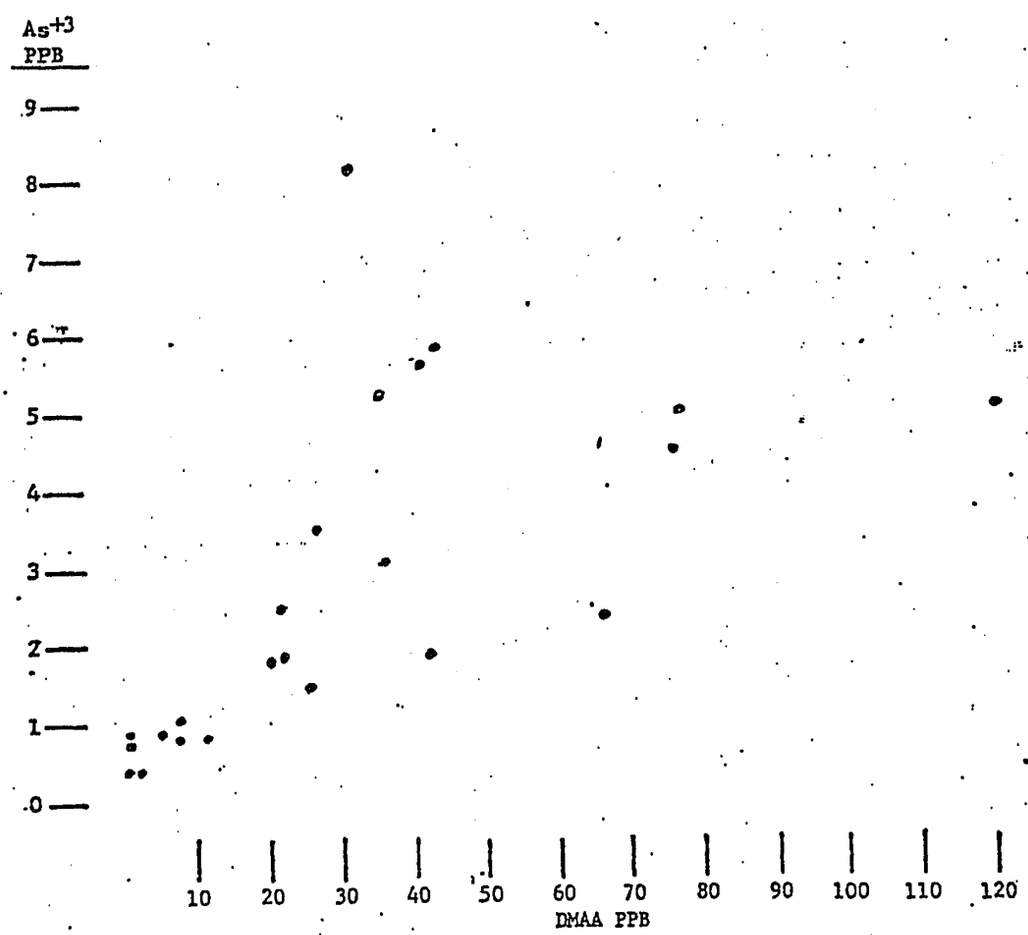
AVERAGE URINARY ARSENIC LEVELS (PPM)

DURING AND AFTER STRIKE AT THE TACOMA SMELTER 1974

	DURING			AFTER		
	7-19-74	7-25-74	AVERAGE	8-20-74	8-22-74	AVERAGE
CHILD 1	.17	.34	.25	.68	.63	.655
CHILD 2	.27	.07	.17	.16	.41	.285
CHILD 3	.01	.08	.045	.11	.06	.085
CHILD 4	x	.14	.14	.10	.13	.115
CHILD 5	.01	.04	.025	.03	.05	.04
CHILD 6	.01	.04	.025	.04	.08	.06
CHILD 7	.04	.08	.06	.09	.10	.095
CHILD 8	.03	.08	.055	.06	.05	.055
CHILD 9	x	.06	.06	x	.22	.22
CHILD 10	.02	.01	.015	.02	.03	.025
ALL			.08			.16

FIGURE 2

Correlation of As^{+3} and DMAA in individual urine specimens



Chemical Forms of Arsenic in Urine

Average concentration for 23 Ruston residents by age

Age.	N	As^{+3}	As^{+5}	MAA	DMAA
2-7	6	4.5	2.9	5.5	63.1
8-9	5	3.5	1.1	3.2	28.6
10-14	4	2.9	.3	3.1	26.5
Adult	8	1.0	.4	.7	12.0*

* 4.2 without 1 outlying result
MAA = methylarsonic acid
DMAA = dimethylarsinic acid

TABLE 2
URINARY ARSENIC (PARTS PER MILLION) FOR RUSTON PRESCHOOL CHILDREN
1976

Age	Date/Day 8/26 Thur.	8/27 Fri.	8/28 Sat.	8/29 Sun.	8/30 Mon.	8/31 Tues.	9/1 Wed.	Average
4	.06	.05	.16	.09	.22	.03	.03	.091
4	.10	.14	.12	.10	.30	.12	.10	.140
5	.09	.05	.14	.10	X	.04	.06	.080
4	.02	.02	.01	.02	.02	.03	.03	.021
5	.40	.40	.15	.27 SF	.25	.31	.16	.277
3	.10	.01	.08	.11 SF	X	.03	.36	.115
Average	.128	.122	.110	.115	.198	.093	.123	.122

X = no specimen
SF = ate shrimp

TABLE 3
URINARY ARSENIC (PARTS PER MILLION) FOR RUSTON SCHOOL CHILDREN
1976

	Age	Date/Day 7/23 Fri.	7/24 Sat.	7/25 Sun.	7/26 Mon.	7/27 Tues.	7/28 Wed.	7/29 Thur.	7/30 Fri.	7/31 Sat.	8/1 Sun.	Average
Family No. 1												
Child 1	10	.03	.03	.02	.05	.02	.08	.08	.03	X	X	.043
Child 2	9	.03	.08	.04	.06	.07	.04	.04	X	X	X	.051
Child 3	12	.03	.04	.04	.04	.03	.03	.03	.01	X	X	.031
Family No. 2												
Child 1	8	.16	.11	.05	.08	.13	.26	.11	.08	.10	.07	.115
Child 2	10	.04	.08	.04	.07	.07	.06	.09	.04	.05	.11	.065
Child 3	6	.14	.22	.10	.17	.12	.22	.07	.06	.19	.07	.136
Family No. 3												
Child 1	6	.05	.11	.03 SF	.59	.13	.04	.18	.15	.20	.80	.228
Child 2	9	.09	.10	.09	.06	.07	.18	.17	.06	.17	.19	.118
Child 3	10	.04	.10	.03	.05	.10	.08	.06	.07	.04	.46	.103
Child 4	7	.10	.09	.06 SF	.20	.06	.11	.14	.17	.20	.89	.202
Average		.071	.096	.050	.135	.080	.112	.097	.074	.136	.370	.114

SF = ate salmon
(= no specimen

Urinary Arsenic (micrograms per liter)

Sampling Date	Number of individuals sampled	Group Studied	Minimum	Maximum	Average
6-6-72	19	Ruston School	10	150	81.8
6-7-72	16	Fern Hill School	10	50	20.0
6-7-72	9	Ruston Preschool Children	40	620	270.0
9-12-72		Traverse Study of Ruston and Tacoma within:			
	7	.5 mi. of stack	50	620	300.0
	8	.5 - 1.0 mi. of stack	50	420	190.0
	6	1.0 - 1.5 mi. of stack	40	140	80.0
	5	1.5 - 2.0 mi. of stack	40	100	60.0
	6	2.0 - 2.5 mi. of stack	N.D.	50	20.0
	5	2.5 - 3.0 mi. of stack	10	100	46.0
	5	3.0 - 3.5 mi. of stack	10	50	34.0
	10	3.5 - 4.0 mi. of stack	10	110	48.0
10-11-72 10-25-72 10-30-72 11-6-72 11-13-72	14	Ruston Children Average of 5 weekly samples	20	470	99.0
9-18-73	107	Ruston School Children	N.D.	430	81.0
10-25-73	106	Ruston School Children	10	470	55.0
7-19-74	8	Ruston Children (Smelter	10	270	70.0
7-25-74	10	on strike)	10	340	94.0
8-20-74	9	Ruston Children (after	20	680	143.0
8-22-74	10	Smelter strike)	30	630	176.0
6-3-75		Ruston School Children			
	5	Seafood ingestion	30	190	102.0
	36	No seafood ingestion	20	660	87.0
6-3-75		Fern Hill School Children			
	13	Seafood ingestion	10	270	62.0
	48	No seafood ingestion	10	230	25.0
11-17-75	102	Ruston School Children	10	200	40.0
	17	Seafood ingestion	10	150	68.0
	85	No seafood ingestion	10	200	35.0
7-23-76 through 8-1-76	10	Ruston School Children for 10 days each	20	890	114.0
8-26-76 through 9-1-76	6	Ruston Preschool children for 7 days each	10	400	122.0
6-30-83	22	N. Tacoma Children	10	116	36.0
	27	Vashon Island Children	< 10	116	23.0
	22	Olympia Children	< 10	87	12.0

... 200 ppm or if 20 micrograms per liter

RECOMMENDATIONS

1. SETTING A COMMUNITY 24-HOUR AMBIENT AIR ARSENIC STANDARD

2. ESTABLISHING AN AIR SAMPLING NETWORK IN THE IMPACTED COMMUNITIES TO MONITOR AMBIENT AIR ARSENIC

3. MONITORING URINARY ARSENIC LEVELS OF PEOPLE RESIDING IN THE IMPACTED COMMUNITIES ON A REGULAR BASIS

Table 1

1969-74 Average Annual

School	Attendance(A)	Enrollment(B)	A/B
Ruston	134	141	.95
Sherman	591	637	.93
Point Defiance	451	477	.95
Truman	578	605	.96
Fern Hill	650	688	.94
Larchmont	342	362	.94
Oakland	189	201	.94

MORBIDITY STUDIES

PURE TONE HEARING SCREENING TESTS DONE IN THE RUSTON ELEMENTARY SCHOOL GAVE SIMILAR RESULTS TO THOSE DONE AT OTHER TACOMA ELEMENTARY SCHOOLS.

PURE TONE THRESHOLD AUDIOMETRY DONE ON 7 RUSTON CHILDREN WITH HIGH URINARY ARSENIC LEVELS ($\geq$ .2 PPM ON 2 OR MORE SAMPLE DAYS) WAS NORMAL.

CHROMOSOME ANALYSIS (SISTER CHROMATID EXCHANGE) WAS NORMAL IN 5 ARSENIC EXPOSED RUSTON CHILDREN AND IN 5 UNEXPOSED CONTROLS.

GROWTH AND DEVELOPMENT OF RUSTON SCHOOL CHILDREN, AS MEASURED BY HEIGHT AND WEIGHT ATTAINED AT A GIVEN AGE, WAS FOUND TO AGREE WITH U.S. AVERAGES. ACADEMIC AND PHYSICAL PERFORMANCE OF RUSTON ELEMENTARY SCHOOL CHILDREN WAS SIMILAR TO THAT OF OTHER TACOMA ELEMENTARY SCHOOL CHILDREN.

Table 3

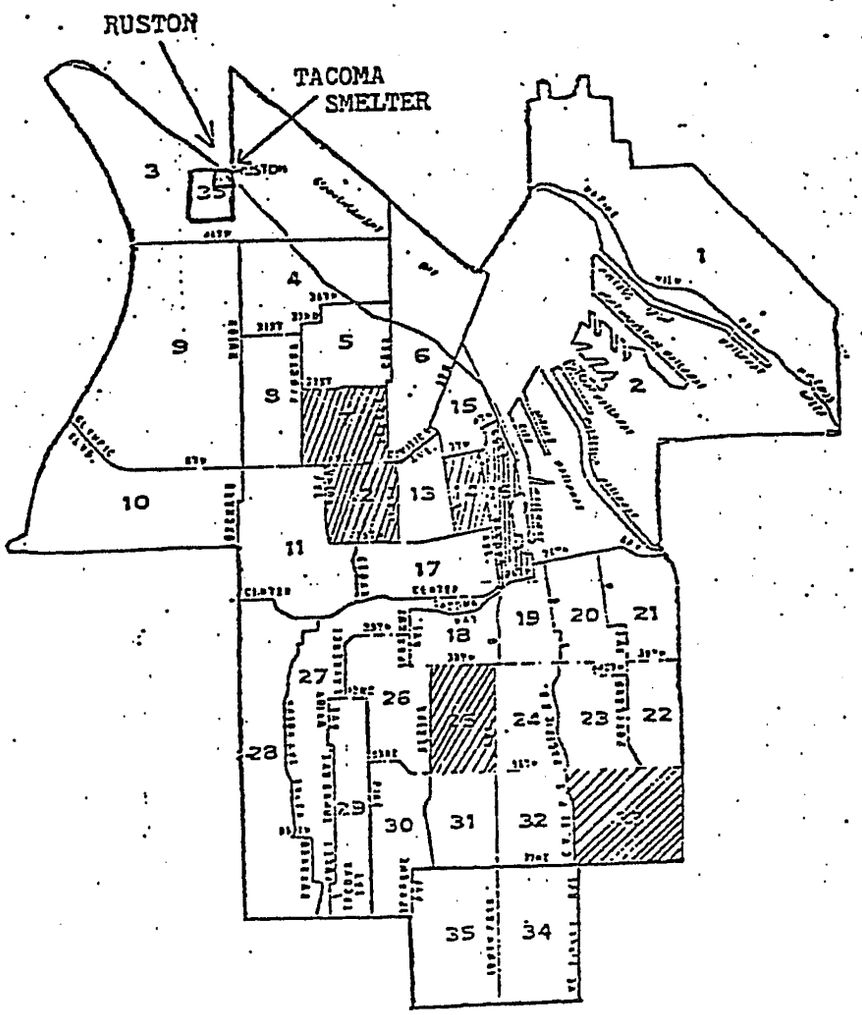
Average Blood Values, Ruston and Fern Hill Schools, Grades 3-5
May, 1975

			Normal Values (Wintrobe(4))	
	Ruston	Fern Hill	Age 6-10	Age 11-15
Red Blood Count (millions/cu.mm.)	4.48	4.71	4.7	4.8
Hemoglobin (gm/100 ml)	13.0	13.6	12.9	13.4
Hematocrit (vol. of packed RBC/100 ml)	37.2	38.8	37.5	39.0
Mean Corpuscular Vol. (cμ)	82.4	81.8	80	82
Mean Corpuscular Hemoglobin (γγ)	28.9	29.9	27	28
Mean Corpuscular Hemoglobin concentration (%)	35.3	36.7	34	34
White blood count (per cu. mm.)	5,720	6,080	8,100	8,000
Percent granulocytes	46.3	49.0	50	51
Percent lymphocytes	47.6	43.6	39	38

Lung Cancer Mortality Near a Copper Smelter - Hartley

Figure 1

City of Tacoma and Ruston



Significant (P<.05) SMR elevations for lung cancer